

# Privacy Concern in Ubiquitous Society and Research on Consumer Behavior

Yumi Asahi

Department of Management Science, Faculty of Engineering,  
Tokyo University of Science  
1-3,Kagura-zaka, Shinjuku-ku, Tokyo, 162-8601  
asahi@ms.kagu.tus.ac.jp

**Abstract.** Ubiquitous means being present everywhere at the same time, which expresses the situation that users can have no trouble accessing computers and networks from anywhere, anytime. This broadens its prospect in marketing. On top of the customer information and buying history that the company keeps track of, the customers' environment information including time, place and activity field has become available. These days, due to ubiquitous marketing, concierge-styled service becomes a real possibility. This is where various suggestions are provided according to users' interests, thoughts and behavioral patterns. This research explains consumer awareness based on a questionnaire survey about consumers' privacy in ubiquitous marketing.

**Keywords:** Classifying respondents, Cluster analysis, Covariance structure analysis.

## 1 Introduction

Anyone can access networks to obtain information and services no matter when they need them. This means various information can be collected by anyone, anywhere, any time. In other words, personal information associated with privacy is also collected [2]. Consumer information such as age, address, sex and annual income is utilized in existing one-to-one marketing [1]. Ubiquitous society allows us to collect and analyze a large amount of consumers' personal information for marketing [4]. The information includes real time location, buying history, status of product use, etc. Although the Private Information Protection Law was enacted in 2005, it is still difficult to obtain consent for the use of personal information. The situation of unsolicited email is not yet resolved [3]. What information do people hesitate to provide and what information are they willing to provide in the name of privacy? This research explains consumer awareness based on a questionnaire survey about consumers' privacy in ubiquitous marketing.

## 2 Questionnaire Survey on Privacy

In this research, a questionnaire survey was conducted with students who have previously used ubiquitous marketing services. In this survey the target was 174 aged

19 or over living in the Tokyo metropolitan area. Survey sheets given to the targets by hand were collected after filling out the answers. It was comprised of 25 questions about privacy awareness. The questions were related to 'status of ubiquitous availability', 'providing privacy information' and 'privacy information leaks'. Major items were answered using five stage assessment system except for the question regarding respondent information. Respondents to the data to be used in the analysis are 174 persons (male: 106, female: 68). The following items are included in the question items:

- Q1. "Personal data may be used only if it provides any benefit as long as it isn't misused."  
 Q2. "Personal data may be disclosed depending on a condition as long as the individual isn't identified."  
 Q3. "To what extent do you agree to disclose your information to receive data distribution from stores?"  
 Q4. "To what kind of stores do you agree to provide information?"  
 Q5. "With what kind of merchandise information do you agree to provide?"  
 Q6. "How do you feel about information provision based on personal data utilization which is useful for you?"  
 Q7. "Do you want to use such system as to distribute information from stores for you to select a store when you eat out?"  
 Q8. "Do you want to use such system as to distribute information from stores for you to select a store when you go shopping?"  
 Q9. "Do you want to use such system as to distribute information from stores for you when you go to supermarkets?"  
 Q10. "Have you ever used any such information provision service as described from Q7 to Q9?"  
 Q11. "I feel my personal data is used for other purpose while I'm unaware."  
 Q12. "How do you tolerate for leakage of your registration information?"  
 Q13. "Does what kind of privilege make you agree to disclose your personal data?"  
 Q14. "Assuming a situation where you're shopping at a supermarket, how frequently do you want to receive discount information?"  
 Q15. "While you aren't shopping, how frequently do you want to receive discount information?"

### **3 Analysis on Privacy**

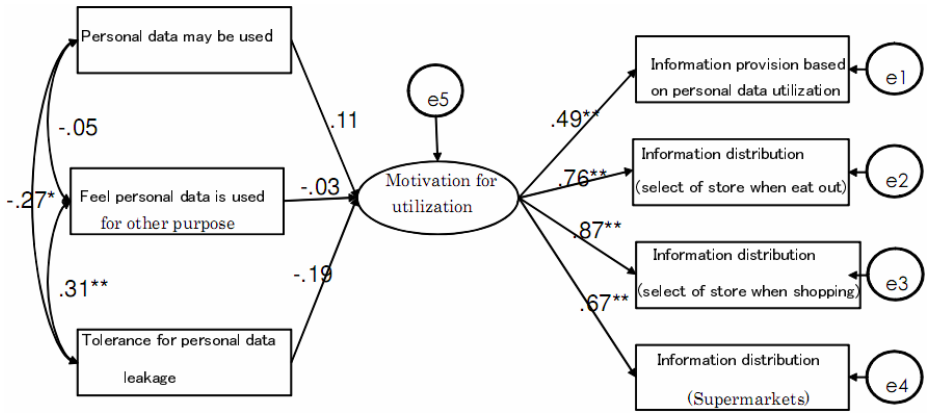
#### **3.1 Flow of Analysis**

First, the author demonstrates a relationship between willingness to use distributed information and views on personal data among respondents using covariance structure analysis. Then, the author analyze whether any difference is found in answer items for the questions by classifying respondents based on their views on personal data using cluster analysis. Further, the author analyze whether any difference is found in answer items by gender.

#### **3.2 Relationship between Views on Personal Data and Willingness to Use Information Distribution Service**

As a certain level of strong correlation has been found between four variables, i.e. Q6 Information service based on personal data utilization, Q7 Whether you want to use

information distribution service from stores in selecting a store when you eat out, Q8. Whether you want to use information distribution service from stores in selecting a store in case of shopping and Q9 Whether you want to use information distribution service from stores when you go to supermarkets, a model is shown in Fig.1, which depicts how consciousness to personal data has impacts on “motivation for information distribution service utilization”, based on an assumption that a potential consciousness as the “motivation for information distribution service utilization” exists behind these four variables.



**Fig. 1.** Model of Casual Relation Between Consciousness to Personal Data and Motivation for Information Distribution Utilization

In the Fig.1, figures with \*\* mark and \*mark indicate that the path coefficients are significant at the 1% level and 5% level respectively and those without any mark indicate that it isn't significant at the 5% level. Since p-value is at isn't rejectable level of 0.785 based on fit index, the model is acceptable. In addition, GFI and AGFI were 0.977 and 0.940 respectively. The model is determined to be well applicable, since a model is supposed to be better applicable as both GFI and AGFI get closer to 1[5] [6].

In terms of path coefficient, any path to “motivation for information distribution service utilization” from each variables, i.e. “personal data may be used”, “I feel personal data is used for other purpose” and “generosity for personal data leakage”, wasn't significant. Therefore, it is conceivable that those who agree that personal data may be utilized don't necessarily want to receive information provision based on personal data, and that those who feel it unforgivable that personal data is leaked don't necessarily regard information service based on personal data to be needless. In other words, it may be said that there isn't strong relationship between “view on personal data” and “motivation for utilization of information service based on personal data”.

Then, we perform simultaneous analysis of multiple populations by dividing population into two groups by gender using the model in Fig.1. Judging from the fit indexes resulted from analysis result, such as p-value of 0.441, GFI of 0.926 and AGFI of 0.833, the model is determined to be well applicable. As a result of the analysis, any path to “motivation for information distribution utilization” from “personal data may be used”, “I feel personal data is used for other purpose” and “generosity for personal data leakage” wasn’t significant at the 5% level neither in male population nor in female population. It may indicate that there is no relationship between “view on personal data” and “motivation for utilization of information service based on personal data”. Correlation coefficients between “personal data may be used”, “I feel personal data is used for other purpose” and “generosity for personal data leakage” are shown for each population in Table 1.

**Table 1.** Path coefficient in Multiple Populations

Feel is is used for other purpose	⇔	For personal data leakage	0.415**	0.119
Personal data may be utilized	⇔	Feel it is used for other puposes	-0.259	-0.273
Personal data may be utilized	⇔	Tolerance for personal data leakage	-0.117	0.385*

\*\* : significant at 1%, \* : significant at 5%. : significant at 10%

Positive correlation is found between “I feel personal data is used for other purpose” and “generosity for personal data leakage” in male population, whereas significant correlation isn’t recognized in female population. It may indicate that “those who feel it unforgivable to leak personal data” have a stronger tendency to think as “I feel personal data is used for other purpose” in case of men. In case of women, on the other hand, it may be said that “those who feel it unforgivable to leak personal data” have a stronger tendency to think as “I don’t want personal data to be used”, since there is a positive correlation between “personal data may be used” and “generosity for personal data leakage” in case of women while there isn’t significant correlation between them.

### 3.3 Feature Analysis by Group

**Classification of Respondent.** Subsequently, the author perform a cluster analysis for classifying respondents by their views on personal data. Using three variables, i.e. “personal data may be used (five-grade evaluation)”, “I feel personal data is used for other purpose (five-grade evaluation)” and “generosity for personal data leakage (five-grade evaluation)”, Ward method has been used to combine clusters. As a result of the analysis, respondents have been classified into three groups. Mean value of each group is shown in Fig.2, and features interpreted by number of respondents and name of each group as well as by mean values are shown in Table 2.

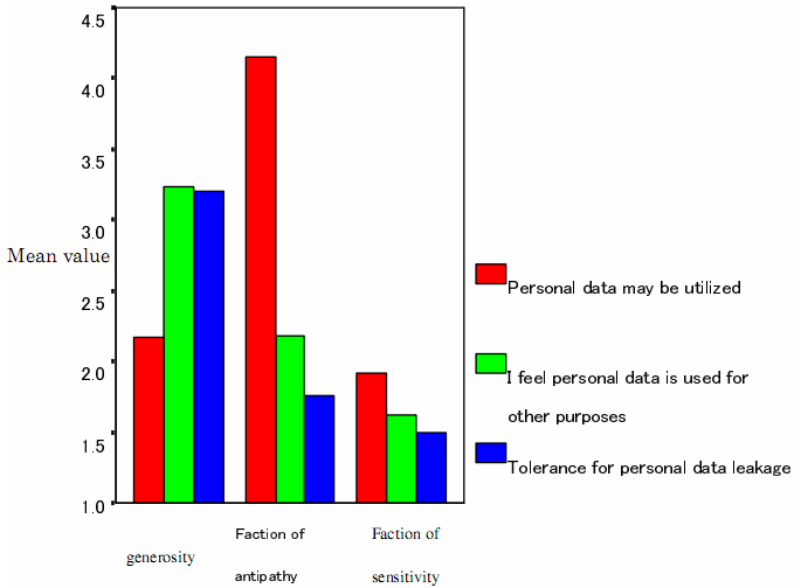


Fig. 2. Mean values of variables in each group

Table 2. Characteristics in each group

	Number of members	Name of group	Features
Group 1	60	Faction of generosity	Those who agree with exploitation of personal data and don't care so much about usage of personal data for other purpose as well as its leakage
Group 2	66	Faction of antipathy toward usage	Those who neither accept personal data to be exploited nor feel its leakage to be forgivable
Group 3	48	Faction of sensitivity	Those who accept personal data to be exploited but wonder if it is used for other purpose and feel its leakage to others to be unacceptable

**Feature Analysis on Groups.** Subsequently, the author analyze what find of features are recognized in each group. Cross-tabulation about group and gender is shown in Table 3. Even though it is recognized in Table 3 that there is a tendency that slightly larger number of men belong to the faction of e and that slightly larger number of women belong to the faction of the faction of antipathy toward usage, it is conceivable that there isn't so statistically significant relationship between gender and group since the result of chi-square test shows each value of  $\chi^2$  and p to be 1.005 and 0.605 respectively, which means it isn't at a level to be rejected. Further, comparing mean values obtained from t-test which has been performed based on gender for variables of Q1, Q10 and Q11, all of them hadn't significant difference at the 5% significance level.

From this result, it may be said there isn't great difference in consciousness by gender over how personal data is used. Cross-tabulation about group and application experience of information distribution service is shown in Table 4.

**Table 3.** Relationship between groups and gender

	Group			Total
	Faction of generosity	Faction of antipathy toward usage	Faction of sensitivity	
Gender male frequency	40	36	30	106
Percentage within group	66.7%	54.5%	62.5%	60.9%
Gender female frequency	20	30	18	68
Percentage within group	33.3%	45.5%	37.5%	39.1%
Total frequency	60	66	48	174
Percentage within group	100.0%	100.0%	100.0%	100.0%

**Table 4.** Relationship between variables and service usage experience

	Group			Total
	Faction of generosity	Faction of antipathy toward usage	Faction of sensitivity	
Usage of information distribution service - experienced frequency	28	28	16	72
Percentage within group	46.7%	42.4%	33.3%	41.4%
Usage of information distribution service – not yet experienced frequency	12	28	22	62
Percentage within group	20.0%	42.4%	45.8%	35.6%
Usage of information distribution service – unknown frequency	20	10	10	40
Percentage within group	33.3%	15.2%	20.8%	23.0%
Total frequency	60	66	48	174
Percentage within group	100.0%	100.0%	100.0%	100.0%

In Table 4, number of those who have less application experience tends to be rather smaller in faction of generosity and it is conceivable that there is no relationship since the result of chi-square test shows values of  $\chi^2$  and p to be 6.099 and 0.192 respectively, which means it isn't at a level to be rejected. Therefore, it may be said that neither remarkably larger is the number of those who have experienced the use of "information distribution service in which some information is timely sent from stores" nor smaller is the number in certain group. Thus, those who are generous for personal data exploitation don't necessarily use information provision service and those who don't want their personal data to be utilized don't necessarily refuse to use such service.

Further, one-way analysis of variance, which was performed to examine whether there is any difference between mean values of variables of "frequency of service information reception (when shopping)" and "frequency of service information reception (when not shopping)", has proved that mean values aren't different between groups since both values weren't significant at the 5% level. Therefore, it may be said that there isn't much relationship between views on personal data and frequency to receive service information.

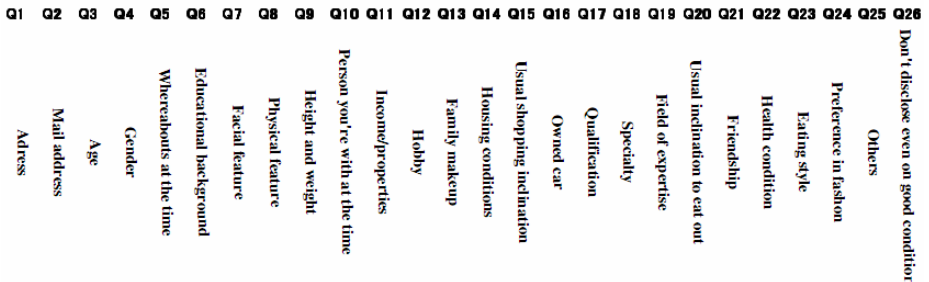
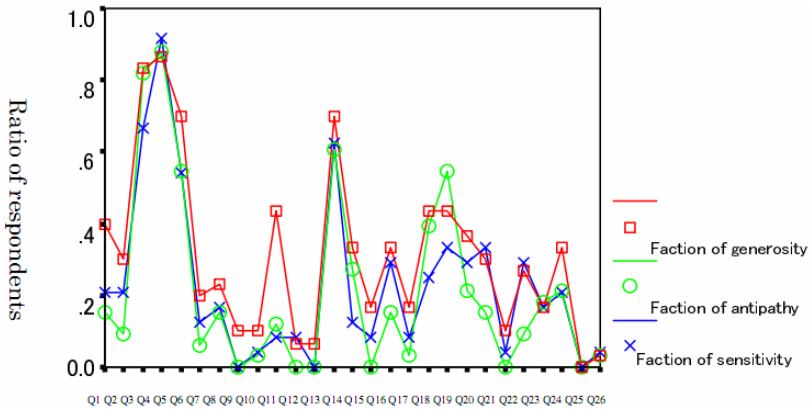


Fig. 3. Ratios of data for which respondents are acceptable to disclose

In terms of a question “what you think it acceptable to be disclosed”, ratios of those who answered positively to the question are shown by items in Fig.3. Vertical axis indicates how many respondents answered as “acceptable” when the total is taken as 1.0.

As a whole, it may be recognized that the ratios of those who responded it acceptable to provide information of “age”, “gender”, “hometown” and “hobby” tended to be higher, whereas that of those who responded positively to “current whereabouts”, “features of face and body”, “income and asset”, “owned car” and “friendship” tended to be lower. In addition, as a tendency by groups, it is recognized that the ratio of those who answered it acceptable that “address” and “mail address” are disclosed is rather higher in “faction of generosity”. Moreover, it is also recognizable that even “faction of sensitivity” and “faction of antipathy toward utilization” tended to show higher rate of those who responded it acceptable to provide information of “age”, “gender” and “hobby”. The ratio of those who answered acceptable for “information acceptable for providing to stores for their information distribution” is shown by items in Fig.4. As a whole, it is recognizable that the ratios of those who answered it acceptable to provide to the extent of “favorite food” and “visiting frequency/usage history” are higher and the ratios of those who did it acceptable to provide information of “address and name” “annual income and

allowance”, “whereabouts” and “person you’re with” are lower. As a tendency in groups, the ratio of those who agree to provide address and name tends to be rather higher in “faction of generosity”, while the ratio of those who responded it depending on benefits such as coupon. However, it is observed as a whole that there isn’t such large difference in tendency between groups.

The ratios of those who responded positively to the item of “to what kind of stores do you acceptable to provide such personal data as shown in Q2” are shown by items in Fig. 5. As a whole, the ratio of those who responded it acceptable to provide for “department store”, “electronics retail stores” and “restaurants” tended to be higher while that of those who responded it acceptable to provide to “drug stores” lower. As a tendency by groups, the ration of those who responded it acceptable to provide to “electronics retail stores” and “convenience stores” is rather lower in “faction of antipathy toward exploitation” than in other two groups and even the former faction tends to be acceptable to provide their information only to “department stores” and “restaurants”.

The ratios of those who responded positively to the item of “about what kind of product information do you accept to provide”. As a whole, it is recognizable that those who responded it acceptable to provide information about “foods” tended to be higher, whereas that of those who responded it acceptable to provide information of “livingware” and “medical goods” to be lower. As a tendency by groups, although the ratio of those who responded it acceptable to provide information about only “clothes” tended to be rather higher in “faction of generosity” than in other two groups, it is recognizable that there isn’t such large difference in tendency between groups.

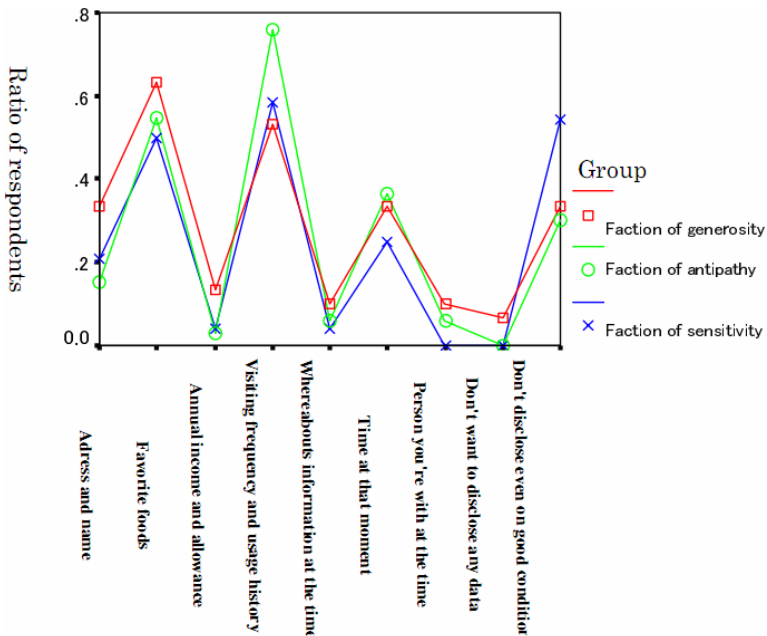


Fig. 4. Ratios of data of respondents which is need for information distribution



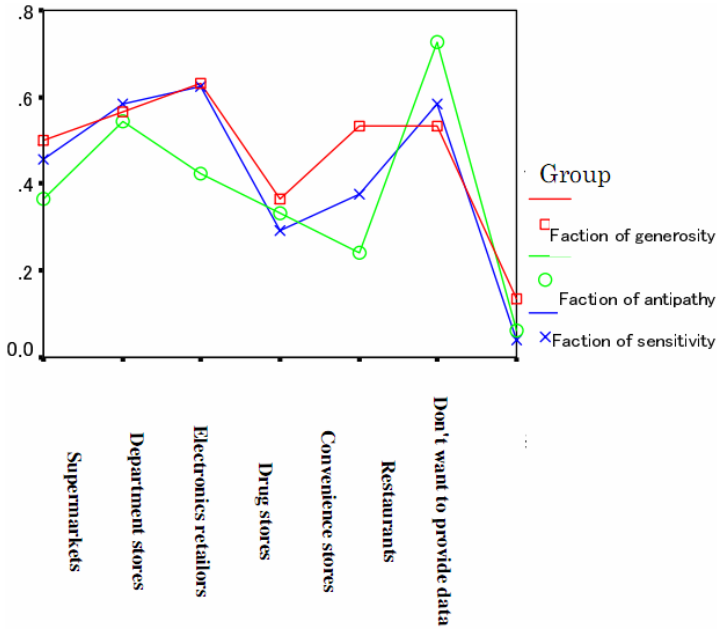


Fig. 5. Ratios of stores respondents are acceptable to provide its information

## 4 Conclusion

Respondents have been classified into three groups by their views on personal data. Each group has such characteristics that “faction of generosity” which is generous to leakage of personal data to some extent with generosity for its use, “faction of sensitivity” which is unforgivable against leakage of personal data but doesn’t mind such data to be used and “faction of antipathy toward utilization” which is unforgivable against leakage of personal data and unacceptable to its use as well.

In terms of information which was thought to be acceptable to be provided to stores for distributing information, it has been proved that more people thought it acceptable to provide “favorite foods” and “visiting frequency and usage history” and that less people thought it acceptable to provide “address and name”, “annual income and allowance”, “whereabouts information” and “person you’re with” as a whole. It has also been proved that “faction of generosity” tended to provide “address and name” more positively than other two groups. In terms of stores for which personal data was allowed to be disclosed, it has been proved that more people thought it acceptable to disclose only “department stores” and “restaurants” and that even “faction of antipathy toward exploitation” tended to think it acceptable to disclose the same as a whole. In terms of product information which was acceptable to be provided, it has been proved that more people tended to think it acceptable to provide only “foods” and that less people tended to think it acceptable to provide “livingware” and “medical goods” as a whole. As an overall tendency, there wasn’t that much difference by groups. In terms of perks for which people thought it acceptable to

disclose personal data, it has been proved that more people thought it acceptable to disclose only tangible goods such as “money/point” and “goods and services” as a whole. Without much difference in tendencies by groups, it has been proved that more people even in “faction of antipathy toward exploitation” and “faction of sensitivity” thought it acceptable to disclose personal data for tangible goods. In the future, it is important for companies to focus on how they collect as much information as consumers give consent to and how they apply the information to marketing, as well as clearly disclose how personal information is collected.

## References

1. Mitani, K.: CRM marketing strategy. Toyo Keizai, Inc. (2003)
2. Nakagiri, D.: Web marketing and consumer behavior. *Japan Society for Information and Management* 29(3), 23–28 (2008)
3. Nishihira, K.: Marketing strategy in Internet space and methodology of consumer action research –Viewpoint of modern and postmodern. *A Treatise on Electricity and Magnetism, Research of quotient study* 27, 53–67 (2007)
4. Sakamoto, K.: Information strategy of Japan of the 21st century. Iwanami Shoten, Japan (2002)
5. Toyoda, H.: Kyobunsan kozo bunseki (kozo hoteishiki moderingu) [gijyutsu hen] [Covariance structure analysis (Structural equation modeling) [Technological chapter]] [summary]. Asakura Shoten Inc., Japan (2003)
6. Toyoda, H.: Kyobunsan kozo bunseki (kozo hoteishiki moderingu) [nyumon hen] [Covariance structure analysis (Structural equation modeling) [Introductory chapter]] [summary]. Asakura Shoten Inc., Japan (1998)